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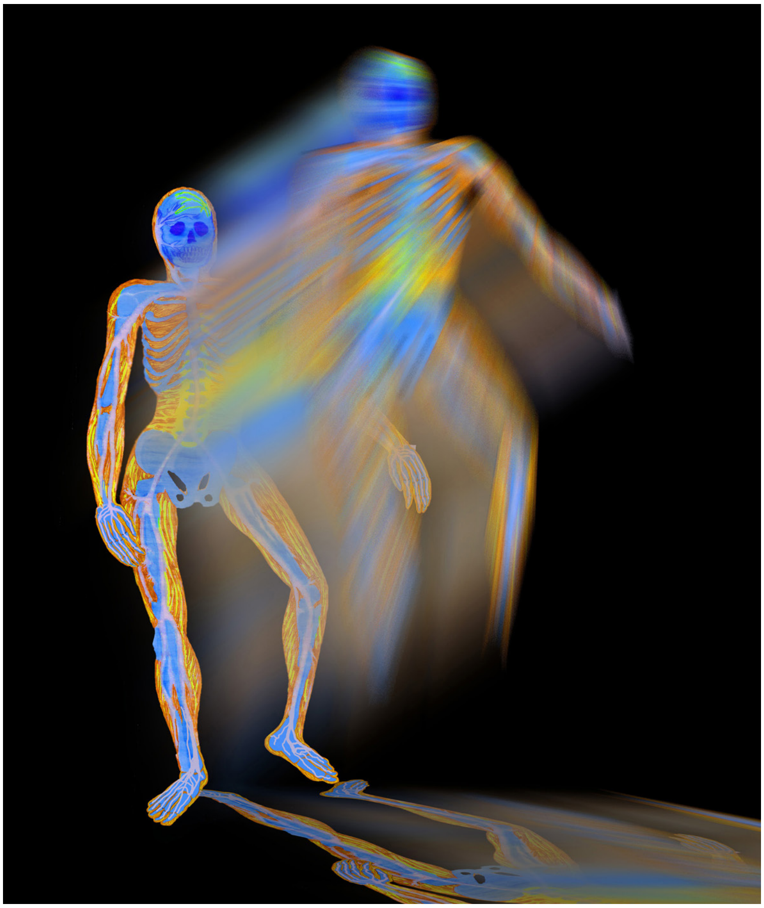

The Future of Perceptual Manipulation

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Out-of-body episodes have traditionally been associated with potent psychedelic agents, dream-like states, or near-death experiences. With the rise of more advanced technology, however, it appears that out-of-body experiences can be triggered much more easily. Equipment with various levels of sophistication has been used to trick a subject's brain into accepting ownership of a different body or body part, facilitating the sensorial deception known as body transfer illusion. To ensure the successful production of this effect, bottom-up mechanisms must override top-down processes. In other words, basic sensory inputs must trump knowledge-activated cognition.

The earliest identified example of a body transfer illusion is the rubber hand illusion. In this experiment, the subject views a fake hand being stroked by a paintbrush, while his or her hand hidden from view is synchronously stimulated. Most subjects attribute the sensations on their own hand to the stimuli being applied to the dummy hand, equating their hand with the dummy hand1. In addition to exposing an interesting mechanism linking the brain and body and revealing a part of how the brain maintains a concrete representation of the body, this research has important clinical implications. Dr. Alexander Mussap, a professor of psychology at Deakin University, has extensively studied the rubber hand illusion and suggests a possible therapeutical use. He believes that these body transfer illusions can be used for the treatment of various body image disorders and notes that "our sense of self is surprisingly malleable"2. Although these are still extremely novel ideas, they may lay the groundwork nd psychological fields. The unraveling of the rubber hand and other body ownership illusions has led to novel experiments in virtual reality, opening up the possibilities for psychological applications that are itching to be explored.

The brain has the remarkable ability to decipher and process the interaction of various sensory modalities by utilizing a mechanism called multimodal integration. By manipulating sensory perspectives, a body transfer illusion can disturb these precise connections, resulting in a misidentification of something seemingly well-known to the subject, such as his or her own hand.

The mechanisms involved in body transfer illusions, however, are far from being the only identified neurological disturbance with a perceptual consequence. The "phantom limb" phenomenon, terminology coined by American neurologist Silas Weir Mitchell, has illuminated some important concepts in the field of cognitive neuroscience. This sensation that an amputated or missing part of the body is still attached and fully functioning has been further investigated by Dr. Vilayanur Ramachandran, a prominent neurologist in the fields of psychophysics and behavioral neurology. Ramachandran studies neurological syndromes to examine the relationship between human mental function and the respective neural processes. A central aspect of his research was the mapping of the cortical homunculus, a pictorial anatomical representation of the primary motor and primary somatosensory cortices. This map describes the sections of these cortices that process the movement and exchange of sensory information with their corresponding body parts. Using magnetoencephalography (MEG), Ramachandran was able to show that when a body part is amputated, the corresponding cortical area is infiltrated by neurons from another part of the cortical homunculus, presumably giving feeling to the physically vacated area, and demonstrating the malleability of brain mapping3. These critical discoveries suggest that because sensory maps are modifiable, senses of body ownership might be as well.

The rubber hand illusion gave rise to a greater understanding of how sight, touch, and proprioception integrate to contribute to a feeling of body ownership. With the advent of more advanced technology, psychologists have been able to use virtual reality to facilitate the disruption of the normal association between touch and vision. Normally, when our bodies are touched, we interpret the feeling as arising from the same place that was touched. However when these sensory lines are crossed, as occurs in a body transfer illusion, the human brain re-evaluates the available possibilities and reassigns the dislodged sense of ownership elsewhere. Recent research into the experience of body transfer has exploited immersive virtual reality (IVR) to generate remarkable changes in the perception of body ownership, and brain-imaging techniques to illuminate the areas participating in body representation.

Preliminary experiments conducted by Mel Slater and his colleagues from the University of Barcelona focused on male subjects and their experiences in a virtual reality setting2. This experiment consisted of four different perspectives of the same room. In the first virtual scene, the male subject was looking at a seated young girl and a standing woman at the opposite side of the room. When the subject looked down, he would see an empty chair. In another scene, the subject would look down to find the young girl's seated body in place of the empty chair, and the woman standing next to him. Next, the participant's viewpoint shifted towards the ceiling, and he was able to watch the woman stroke the girl's shoulder. Finally, the woman would strike the girl across the face three times.

The subject's experiences were constructed upon combinations of the three following variable factors as allowed by the experimental design: perspective, movement, and touch. The perspective of the subject was either first or third person with respect to the seated girl. Movement refers to the synchronicity of the subject's head movements with those of the girl's. Touch refers to whether or not the subject's actual shoulder was stroked simultaneously with the girl's.

After the virtual reality experience, each participant was subjected to a questionnaire consisting mostly of questions pertaining to body ownership. The movement of the head and the synchronicity of the touch lacked notable effects on perceived body ownership. The most important factor was the subject's perspective, although this effect was enhanced by the combination of a first person perspective with synchronous stroking of the shoulder and movement of the head. They also measured heart rate deceleration (HRD) during the time in which the woman is slapping the girl. HRD, according to John Cacioppo and colleagues, has been shown to occur in response to aversive stress situations, particularly in the context of picture viewing4. During the slap, the subjects. During the slap, the subjects originally in the first person perspective, but now viewing the scene from above, showed a significantly greater heart rate deceleration than those subjects viewing the scene from a third person viewpoint. Clearly, stronger HRD is associated with the feeling of body ownership.

These intriguing and revealing findings demonstrate the malleability of a person's body image and sense of body ownership, and reveal the strength of the connection that participants feel to the virtual body. Slater proposes that the habitual experience of looking down and seeing our own body is so familiar that even the noticeable changes in physical appearance introduced by the experiment won't completely override our visual inputs to the brain, implying a straightforward mental transition into this virtual body2. Previous studies at the Virtual Human Interaction Lab at Stanford University have contributed to this research by creating a virtual environment in which it is possible to change the avatar's height and levels of attractiveness, and to monitor the subject's behavioral changes5. The subjects exhibited the expected behavior according to the Proteus effect5, which appears when an individual's behavior changes with an alteration in the appearance of his or her virtual self. For example, if the subject's avatar is attractive and fit, then the subject will act with more confidence, regardless of how the other virtual characters interact with the subject. This kind of experimentation and interaction also exists on a purely social level. Linden Lab, an American internet company, has developed a virtual world called Second Life6. The so-called "residents" of this world can socialize with other residents through their avatars, and participate in group activities as well as one-on-one interactions. This program is popular for those considering a sex change, as they are able to interact with others in a more comfortable "body".

The Proteus effect, under normal circumstances, does not necessarily transfer to real life change in behavior associated with the virtual reality experience. Manipulating the appearance of a virtual body in a therapeutic setting, however, could lead to the development of psychological therapies for body image disorders, and could be used as preemptive treatments for gender reassignment surgeries.

Although there is still much work to be done in terms of the fundamental experimentation, as well as on development of the therapies, there is undoubtedly tremendous potential in this image disorder research. If it delivers on its promise, this intellectual descendant of a curious mind trick using a rubber hand could shatter the boundaries of the fields of neurology and psychology.

References:

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